Claims

1. A method of manufacturing a semiconductor device of laminating to form a bottom electrode, a dielectric and a top electrode on an underlying substrate having a three-dimensional structure in which

the bottom electrode and the top electrode are formed by an metalorganic chemical vapor deposition process at 180°C or higher and 250°C or lower using a cyclopentadienyl complex as a precursor.

2. A method of manufacturing a semiconductor device as defined in claim 1, wherein one of O_2, H_2, N_2O, O_3, CO and CO_2 is used as a reaction gas and the ratio of the reaction gas to a carrier gas is 1% or more.

3. A method of manufacturing a semiconductor device of laminating to form a bottom electrode, a dielectric and a top electrode on an substrate having a three-dimensional structure in which

the structure having a three-dimensional is constituted of an insulation layer of a 2-layered structure comprising a surface layer with a smaller adhesion rate and a side wall layer with a larger adhesion rate for an electrode precursor, and the bottom electrode and the top electrode are formed by a metalorganic chemical vapor deposition process at 300°C or higher and 500°C or lower using a β-diketone complex as the

precursor.

4. A method of manufacturing a semiconductor device as defined in claim 3, wherein the structure constituted of the 2-layered insulation layer comprises MgO/SiO_2 or Al_2O_3/SiO_2.

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5. A method of manufacturing a semiconductor device as defined in any one of claims 1 to 4, wherein each of the top electrode and the bottom electrode comprises Ru, RuO_2 or a mixture of Ru and RuO_2.

6. A semiconductor device having a dielectric and an electrode applying a voltage to the dielectric in which the electrode is a thin film electrode comprising Ru, RuO_2 or a mixture of Ru and RuO_2 formed on a structure with an aspect ratio of a three-dimensional structure (contact hole depth/diameter) of 3 or more.

7. A method of forming a thin film to the surface and the lateral side of structure having a three-dimensional, in which the structure is constituted of a 2-layered structure formed by laminating a surface layer with a smaller adhesion rate and a side wall layer with a larger adhesion rate of a starting thin film material.

8. A method of manufacturing a semiconductor device of laminating to form a bottom electrode, a dielectric and a top electrode on a substrate having a three-dimensional structure in which,

the bottom electrode and the top electrode are formed by using a starting precursor in which a starting metalorganic material containing a cyclopentadienyl complex is dissolved in tetrahydrofuran, toluene, hexane or octane, by a liquid carrying and evaporation, metalorganic chemical vapor deposition process.

9. A method of manufacturing a semiconductor device as defined in claim 8, wherein the bottom electrode and the top electrode are formed at 180°C or higher and 250°C or lower.

10. A method of manufacturing a semiconductor device of laminating to form a bottom electrode, a dielectric and a top electrode on substrate having a three-dimensional structive in which,

the bottom electrode and the top electrode are formed by using a starting precursor in which a starting metalorganic material containing a β-diketone complex is dissolved in tetrahydrofuran, toluene, hexane or octane, by a liquid carrying and evaporation, metalorganic chemical vapor deposition process.

11. A method of manufacturing a dielectric capacitor as defined in claim 10, wherein the bottom electrode and the top electrode are formed at 300°C or higher and 500°C or lower.

12. A method of manufacturing a semiconductor device as defined in claim 8 or 10, wherein the tetrahydrofuran, the

toluene, the hexane or the octane is a solvent having a solubility for the starting precursor of 0.05 mol/l or more.

13. A semiconductor device formed by laminating a bottom electrode, a dielectric and a top electrode in which the oxygen content of the bottom electrode and the top electrode is 10^{-2} at% or more and 1 at% or less.

14. A semiconductor device manufactured in accordance with the manufacturing method as defined in claim 1, 3, 6, 7 or 10.

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